

WHAT IS CLAIMED IS:

1. Apparatus for treating raw elongate material suitable for use in a paper making plant comprising:

extracting means for extracting contrary material from the raw material;

crushing means for crushing the raw material to remove nodes therefrom;

splitting means for splitting the crushed raw material lengthways;

a co-rotating twin screw conveyor for receiving the crushed raw material and producing pulp and a black liquor effluent, said conveyor being divided into a plurality of zones;

means for inserting treatment material into at least one of said zones;

means for controlling the temperature and/or pressure in at least one of the zones;

and

means for recovery of treatment material and energy from said black liquor, including a processing vessel in the form of a fluidised bed reactor for receiving black liquor.

2. The apparatus of claim 1, wherein the extracting means comprises a conveyor belt provided with means for enabling the removal of contrary material.

3. The apparatus of claim 1, wherein the crushing means comprises a pair of counter rotating knurled rollers between which the raw material passes.

4. The apparatus of claim 1, wherein the splitting means comprises a pair of counter rotating pinned rollers between which the crushed material passes.

5. The apparatus of claim 1 wherein, between the crushing means and the splitting means are provided means for further removing contrary material present in the crushed material.

6. The apparatus of claim 1, wherein the conveyor comprises at least three zones comprising a feed zone, a treatment zone to which treatment material is added and a pressure zone maintained at a pressure above atmospheric.
7. The apparatus of claim 6 wherein the feed zone is enlarged compared to the other zones to allow the raw material to be fed freely therein to increase the throughput of the conveyer.
8. The apparatus of claim 6, wherein the area of the conveyor diminishes progressively in the direction of flow of the material so as to progressively increase the pressure therein.
9. The apparatus of claim 6, wherein the conveyor comprises five zones comprising said feed zone, said treatment zone to which treatment material is added, a first pressure zone at a pressure greater than atmospheric to which treatment material is added, a second pressure zone at a pressure higher than the first pressure zone and a third pressure zone at a lower pressure than the second pressure zone.
10. The apparatus of claim 9, further comprising means for insertion of steam into the treatment zone and means for insertion of pulping agents into the first pressure zone.
11. The apparatus of claim 1, further comprising  
an evaporator for concentrating black liquor from the screw conveyor and  
a closed conveyor for transporting concentrated black liquor from the evaporator to the processing vessel at a temperature in excess of 90°C.
12. The apparatus of claim 1, wherein the fluidised bed contains an earth oxide at a ratio of between 0.2:1 to 1.3:1 earth oxide to black liquor effluent dry solids set up under stoichiometric conditions or sub stoichiometric conditions.
13. The apparatus of claim 12, wherein:

the closed conveyor is a twin screw conveyor, and  
means is provided for supplying an earth oxide to the closed conveyor at a ratio of earth oxide to black liquor of from 0.2:1 to 1.3:1 so that it becomes a granular friable material.

14. The apparatus of claim 1, including means for chemically converting the material in the fluidised bed reactor into sodium hydroxide and/or sodium carbonate and a gas and liquids with a combustible component which can be utilised for energy production.

15. The apparatus of claim 14, further comprising:  
a tank for dissolving the product produced in the reaction vessel;  
means for filtering the non-dissolved solids to separate them from the dissolved reaction product;  
a dryer for drying the undissolved reaction product; and  
a boiler for recovering energy from hot gases.

16. A method for treating raw elongate material suitable for use in a paper making plant comprising:  
extracting contrary material from the raw material;  
crushing the raw material from which contrary material has been removed to remove nodes therefrom; splitting the crushed raw material lengthways;  
supplying the crushed raw material to a co-rotating screw conveyor divided into a plurality of zones and processing said material in said conveyor to produce pulp and a black liquor effluent;  
supplying treatment material to at least one zone;  
controlling the temperature and/or pressure of at least one zone; and  
spraying concentrated black liquor into a processing vessel in the form of a fluidised bed reactor for treatment of said black liquor, said processing vessel being part of treatment material and energy recovery means.

17. The method of claim 16, wherein the extraction of contrary material takes place on a conveyor belt provided with means for enabling the removal of contrary material.

18. The method of claim 16, wherein the crushing of the raw material takes place between a pair of counter rotating knurled rollers between which the raw material passes.

19. The method of claim 16, wherein the splitting of the crushed material takes place between a pair of counter rotating pinned rollers and between which the crushed material passes.

20. The method of claim 16, wherein, between the steps of crushing the raw material and splitting the crushed material, further removal of contrary material present in the crushed material is carried out.

21. The method of claim 16, comprising  
addition of heat, steam or other treatment materials at any point along the co-rotating twin screw conveyor, and/or  
extraction of liquids or volatiles at any point along the co-rotating twin screw conveyor.

22. The method of claim 16, wherein there is an increase or decrease of pressure at any point within the corotating twin screw conveyor.

23. The method of claim 16, wherein the crushed raw material is passed through a screw conveyor having at least three zones comprising a feed zone, a treatment zone to which treatment material is added and a pressure zone maintained at a pressure above atmospheric.

24. The method of claim 16, wherein the crushed raw material is passed through a screw conveyor having five zones comprising a feed zone, a treatment zone to which treatment material is added, a first pressure zone at a pressure greater than atmospheric to

which treatment material is added, a second pressure zone at a pressure higher than the first pressure zone and a third pressure zone at a lower pressure than the second pressure zone.

25. The method of claim 24, comprising controlling the pressure and temperature of the first and third pressure zones to be the same.

26. The method of claim 24, comprising inserting steam into the treatment zone and inserting pulping agents into the first pressure zone.

27. The method of claim 24, comprising maintaining the feed zone and the treatment zone at atmospheric pressure.

28. The method of claim 24, wherein calcium hydroxide is added to the first pressure zone.

29. The method of claim 16, comprising  
passing the black liquor at a concentration of 10-70 % solids to the processing vessel, and  
treating the concentrated liquor therein at a temperature of between 300-650°C.

30. The method of claim 29, comprising concentrating the liquor to 30-70% solids before passing it to the processing vessel.

31. The method of claim 16, comprising receiving black liquor from a co-rotating twin screw conveyor at above 30% solids, passing the concentrated liquor to the processing vessel and treating the concentrated liquor therein at a temperature of between 300-650°C.

32. A method of claim 16, including spraying the concentrated black liquor into the chamber of a toroidal fluidised bed containing an earth oxide at a ratio of between 0.2:1

and 1.3:1 earth oxide to black liquor dry solids and set up under stoichiometric or sub-stoichiometric conditions.

33. The method of claim 32, wherein the concentrated black liquor is fed into a twin screw conveyor with an earth oxide, the ratio of earth oxide to black liquor dry solids being between 0.2:1 and 1.3:1 so that it becomes a granular friable material.

34. The method of claim 16, including chemically converting the material in the fluidised bed into sodium hydroxide and/or sodium carbonate and a gas and liquids with a combustible component which can be utilised for energy production.

35. The method of claim 16, wherein the raw elongate material is straw.

36. A treatment apparatus for treating raw elongate material suitable for use in a paper making plant comprising extracting means for extracting contrary material from the raw material, crushing means for crushing the raw material to remove nodes therefrom and splitting means for splitting the crushed raw material lengthways.

37. A method for treating raw elongate material suitable for use in a paper making plant comprising extracting contrary material from the raw material, crushing the raw material from which contrary material has been removed to remove nodes therefrom and splitting the crushed raw material lengthways.

38. An apparatus for pulping fibrous cellulosic raw material comprising a corotating twin screw conveyor, the conveyor being divided up into a plurality of zones, means for inserting treatment materials into at least one zone and means for controlling the temperature and/or pressure of at least one of the zones.

39. A method of pulping pre-treated raw material comprising passing the raw material through a plurality of zones in a co-rotating twin screw conveyor, inserting treatment

material into at least one zone and controlling the temperature and/or pressure of at least one of the zones.

40. An apparatus for treatment of black liquor effluent produced in a paper pulp manufacturing plant comprising a processing vessel for treating the liquor of a concentration between 10 and 70 percent solids at a temperature of between 300-650°C, and a closed conveyor for transporting the concentrated liquor from the evaporator to the processing vessel in excess of 90°C.

41. A method of treatment of black liquor produced in a paper manufacturing plant comprising, passing the liquor at a concentration of 1070 % solids to a processing vessel and treating the concentrated liquor therein at a temperature of between 300-650°C.